Street Lighting Retrofit Implementation Guide

Author:

Kelly Herbert, Operations Manager

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About the South-central Partnership for Energy Efficiency as a Resource (SPEER)

SPEER is a regional non-profit organization dedicated to increasing and accelerating the adoption of energy efficient products, technologies, and services in Texas and Oklahoma. Much of SPEER's work focuses on finding the best market-based approaches to increase energy efficiency and overcoming persistent market barriers. The views expressed in this paper do not necessarily reflect the views of all of SPEER's members, funders, or supporters. For more information about SPEER, please visit: www.eepartnership.org

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I. INTRODUCTION

Cities have been able to reap substantial savings as a result of retrofitting street lights, in both energy and maintenance savings. By replacing existing street lights with LED-based lamps, cities or utilities can cut energy and operations costs by 40 – 60%. While the process for retrofitting city street lighting is cumbersome, SPEER has worked with member energy service companies (ESCO's) to create business cases that involve cities with proposed or completed projects to demonstrate it is more than worthwhile for cities to pursue these retrofit projects. At a time when many municipalities are facing budget shortfalls, reevaluating how a city pays for street lighting may be an excellent way to save money.

The process outlined below, and described in detail in this guide, is for cities interested in pursuing LED retrofits of street lighting. SPEER compiled this information by interviewing cities, utilities, and energy service companies in the region, as well as reviewing publicly available information. This implementation guide will be used to promote street lighting retrofit projects to cities, counties, and utilities in our region.

Municipal Street Lighting Retrofit Process

1. Determine the availability of LED tariffs
2. Coordinate with all relevant municipal departments and any local utility to conduct an inventory of street lighting in the city
3. Identify any financial incentives
4. Do a high level test of project viability
5. Define the scope of work
6. Explore financial options for retrofit projects
7. Survey potential contractors and develop a specification list for retrofit fixtures
8. Issue a Request for Quote (RFQ)
9. Document the savings of the project after completion

Supporting Business Cases

Actual business cases were obtained to demonstrate the benefits of these retrofit projects. The first was designed by SPEER member company Opterra Energy Services, and highlighted their successful LED retrofit project with the City of Arlington, Texas. The second business case was designed by another SPEER member company Ameresco, and builds upon their many years of experience in city performance contracting. This business case highlights the critical role that LED tariff design plays in project financial outcomes. The Ameresco case study also makes the case for "virtual metering" which can potentially lower the cost for LED retrofits by using newer, less expensive technology to track useage than traditional utility metering.

II. BACKGROUND & OVERVIEW

Street lighting is a significant share of municipals electricity consumption and a major expense item on city budgets, so the potential to capture substantial savings by initiating a project to install and maintain LED street lights is great. **LED street lighting retrofits are estimated to save between 40% and 65% in municipal energy costs**. LED costs continue to improve, as does testing and the reliability of LED for street lighting applications. Several industry pilots are now reporting better than expected outcomes on several parameters such as glare, lighting control, reduced maintenance, etc. And LEDs have been designed to replace all major forms of streetlights: High Pressure Sodium, Metal Halide, and Mercury Vapor. The opportunity for cost savings is even higher when reduced maintenance is factored in and the potential for if upgrades such as advanced networked lighting controls are considered.

Cities in Texas, as well as many around the U.S., are evaluating their current installed outdoor area and street lighting. El Paso, San Antonio, Houston, Arlington, Harlingen, and more have made the upgrade to high efficiency LED street lighting. During these retrofit projects cities found there is often a mix of city owned and utility owned streetlights. Street lighting retrofit projects tend to start with city owned fixtures and lights and then expand, depending on the utility tariffs[1] in place. To date, LED tariff design is a significant barrier for project financial outcomes in most of the utility service territories in Texas. ESCOs report that many projects still "*don't work*" financially, due to the inadequate design of appropriate LED tariffs that capture the lower-wattage retrofit savings. Cities interested in retrofit projects need to know that they have options; they can work with their utility to identify types of lighting for new installations, as well as replacements that can occur on an incremental, end-of -life basis.

Today, utilities have tremendous opportunity to get in front of the trend by working with cities to create a win/win situation that bridges city expectations of reliability and savings from LED retrofits to the business interests of the utility providing the service. Cities are increasingly adopting policies such as the Model Lighting Ordinance developed by the International Dark-Sky Association (IDA) and Illuminating Engineering Society (IES), which specify Design Lights Consortium eligible fixtures.

III. THE PROCESS

1. **Determine the availability of an LED rate or tariffs.** Researching the appropriate rate options for street lighting with the utility will provide the city with the options available for retrofit projects. This information is usually publicly available and in most cases rates that are based on whether street lighting is utility or city owned, metered or unmetered, and then broken down by type and/or wattage of fixture. Review any maintenance agreements as part of this process.

[1] **Tariff** — The schedule of a utility, municipally-owned utility, or electric cooperative containing all rates and charges stated separately by type of service, the rules and regulations of the utility, and any contracts that affect rates, charges, terms or conditions of service.
http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/ch25complete.pdf

Figure 1. Whether a LED tariff exists is the first of many questions, others are: Does the LED rate reflect the anticipated savings if a fixture were to be retrofitted? For example, does a tariff exist for the most common retrofit of 100-Watt HPS to a comparably more efficient LED of 50 watt?

Figure 1: *An example of LED area lighting rate for utility-owned lighting in Texas.*

Lamp Size		kWh per month		Charge per Lamp
50-55 watt (comparable to 100 watt HPS	LED	19	kWh per month	$9.60
100-110 watt (comparable to 250 watt HPS)	LED	38	kWh per month	$20.00
100 watt	HPS*	45	kWh per month	$ 8.15
250 watt	HPS*	110	kWh per month	$16.30
175 watt	Metal Halide*	78	kWh per month	$ 8.15
175 watt	Mercury Vapor*	75	kWh per month	$ 8.15

2. **Cities need to coordinate with their utility, city financing office, and others as needed to conduct an inventory of all street lighting in the city.** The inventory should include the number of lights, the type of light installed and the ownership and maintenance responsibilities, as detailed below. It is noteworthy that energy service companies (ESCO's) often include a detailed inventory with GIS mapping as part of their retrofit contract. Cities with utility owned and operated lighting, should contact their provider for the information listed below.
   - Inventory: number of street lights, fixture type, & wattage (number of metal halide, high pressure sodium, mercury vapor, other). For example: 325 100-Watt HPS
   - For each street light, document whether it is utility owned or city owned, metered or unmetered, and who maintains it. Ownership and operation structures vary city to city, county to county and state to state so it is important to capture this information during the audit phase. There are many cities that own and maintain all of their street lighting, some that may own the lights, but contract out for operations and maintenance, and there are also some electric utilities that own and operate street lighting for cities.

3. **Identify any financial incentives**. Contact the utility commercial energy efficiency program for information and an application. Cities that pay into ratepayer-funded energy efficiency programs on their local utility bill may be eligible for LED retrofit or other commercial efficiency incentives. This can help to decrease the amount spent and/or financed by the city to complete the project.

4. **Do a high-level project financial viability test.** LED lighting in general is one of the most common and cost-effective retrofit options available for improving financial and environmental performance in facilities. It is an important next step to complete a high-level project financial viability test; this will provide the city or utility with the proper information about how the finances of the project will work. Outdoor LED useful life estimates range from 10 to 15 or more years, depending on the application. It is important to note that some lighting experts recommend completing a detailed financial analysis, see below for guidelines and details, in place of a high level analysis.

   Importantly, once the payback for capital cost is recouped, the energy cost savings is then fully realized monthly for the remaining life of the fixture, often earning an attractive rate of return. If the lighting tariff is a barrier to a retrofit project that would otherwise make financial sense, it is then time to complete a detailed financial analysis to present to the utility, or collaborate with other cities with similar barriers and negotiate collectively with the utility for a win/win outcome.

5. **Define the scope of work.** Completing a detailed financial analysis will help define the scope of the project. It is important that the city and the utility work together to review of any maintenance agreements for any of the street lighting to be retrofitted. Whether a city is considering doing the project internally, financing the work internally or planning to utilize an ESCO or other outside contractor, completing a detailed financial analysis of the project will put the city in a more informed position for negotiating with the utility or soliciting contracts.

   A Retrofit Financial Analysis Calculator was collaboratively developed by the DOE Municipal Solid-State Street Lighting Consortium, the Clinton Climate Initiative, the Federal Energy Management Program (FEMP) and DOE Better Buildings for conducting economic analysis of lighting upgrades. The link to this tool provides you with not only the tool, but also provides guidance, a quick start guide and the methodology in the tool. This tool assists with the detailed financial analysis of retrofitting street and parking facility lighting with more-efficient alternatives. Cities or utilities can use the tool to compute annualized energy and energy-cost savings, maintenance savings, greenhouse gas reductions, net present value, and simple cash payback associated with potential lighting upgrades. This information is what will then need to be shared with city leadership and utilities to create buy-in for retrofit projects, as well as negotiate tariffs in an effort to ensure that the project evaluation is transparent and supported by both the city and the utility.

   The financial analysis will also provide cities with valuable information allowing them to prioritize projects, often favoring those with the best metrics for immediate action, then use savings to invest in other efficiency. However, considering more comprehensive retrofit initiatives, or taking a “portfolio perspective,” is a way for projects with more immediate savings to support efficiencies that have a longer return on investment. There are experts that

recommend completing a detailed analysis on retrofitting everything before breaking down retrofits into smaller projects. This approach often works well in performance contracting.

6. **Explore available financing options..** While LED street lighting costs have significantly decreased in recent years, there are still significant upfront labor and material costs for a retrofit project. There are many financing options available some include possible state or federal grants, vendor financing, tax-exempt lease purchase agreements, utility retrofit options, energy service company performance contracts, and in Texas the State Energy Conservation Office (SECO) offers Loan Star Revolving Loans for public facilities, with loans as low as 1-2% per annum for qualifying projects. According to one report, the City of San Antonio utilized the Loan Star Revolving Loan Fund to finance a $1.7M conversion of LED traffic signals and pedestrian lights, achieving an annual savings of $878,000.There are also performance contracting options that give cities a turn-key process with guaranteed savings. In Texas, cities are encouraged to "implement any energy efficiency that pays for itself" through performance contracts.

7. **Survey lighting contractors or suppliers to develop a preliminary specification list for retrofit fixtures.** Discuss the specification list with potential installers such as the utility, internal teams, or 3rd party service providers to arrive at an informed decision. Most lighting experts recommend a brief pilot stage of two or three small retrofit projects including a few different lighting suppliers before making a final decision for a major retrofit. At this time the city should solicit feedback from the community, maintenance personnel, contractors, or others involved in the process. Ensure that final fixtures meet reputable third-party testing lab guidelines, such as the Design Lights Consortium.

An example of an LED roadway retrofit for high pressure sodium.

8. **Issue a Request for Quote (RFQ)** for the cost of equipment and supplies that will be installed by the city, or a Request for Proposal (RFP) for a full-service contract with a third party. If the city is seeking a third party contract, the purchase and installation of the selected fixtures as well as, warranty provisions, compliance with city procurement policies, and a maintenance agreement, should the city be interested in one, will all be included in the RFP. Carefully interview potential contractors for reputation, years in business, and references.

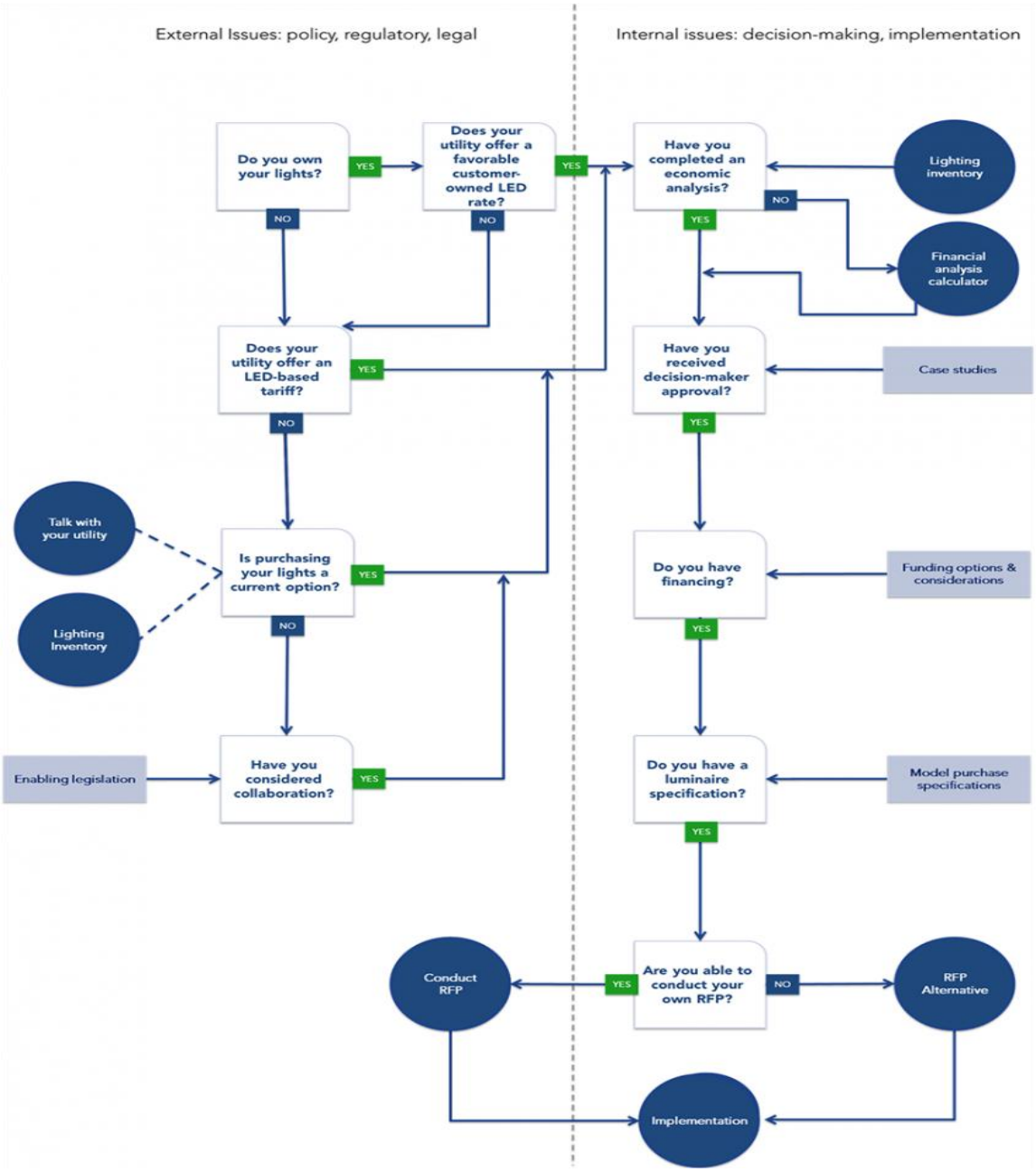
9. **Project completion and documentation of actual project savings**. In order to make the case for the project's success and potential future projects, the city must document and socialize the actual savings of the project after completion. It is important to include the co-benefits that are important to your community such as avoided power emissions and improved air quality, as well as the associated energy savings. EPA continues to maintain an easy-to-use GHG equivalency calculator for calculating these impacts. If the city has contracted with a third-party provider, consider adding this requirement to the contract. Documenting and publishing the success of a lighting retrofit project is often a cornerstone in building the case for future similar projects and helping other cities complete similar projects.

IV. ADDITIONAL RESOURCES

SPEER maintains a menu of resources available for cities in our region to assist them in energy efficiency projects.

Department of Energy Decision Tree Diagram
DOE created a visual decision tree interactive tool which highlights the major steps of the process, reproduced below.

Department of Energy's Outdoor Lighting Decision Tree Tool



[2] Solution at a Glance: Outdoor Lighting Decision Tree Tool: Successful Approaches of Cities, States, and Regional Groups https://betterbuildingssolutioncenter.energy.gov/solutions-at-a-glance/outdoor-lighting-decision-tree-tool-successful-approaches-cities-states-and